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A HARDINESS MAP FOR THE UNITED STATES

THE hardiness of plants is naturally of great interest to all plantmen. It is only by long and careful trials that the northern limits of growth of any particular exotic tree or shrub can be determined. Even when the northern limits of a number of different species become known, it is somewhat difficult to divide the country into hardiness zones that are wholly satisfactory. Many such maps have been prepared, some reasonably satisfactory, others less so. After a careful consideration of all factors, it was felt that the best basis for limiting hardiness zones is the average annual minimum temperatures. The map here offered, first published in **Hedges, Screens and Windbreaks** by Donald Wyman in 1938, and later adopted and enlarged to include Canada by Alfred Rehder in the second edition of his **Manual of Cultivated Trees and Shrubs** (1940), is about as accurate as any small-scale map can be.

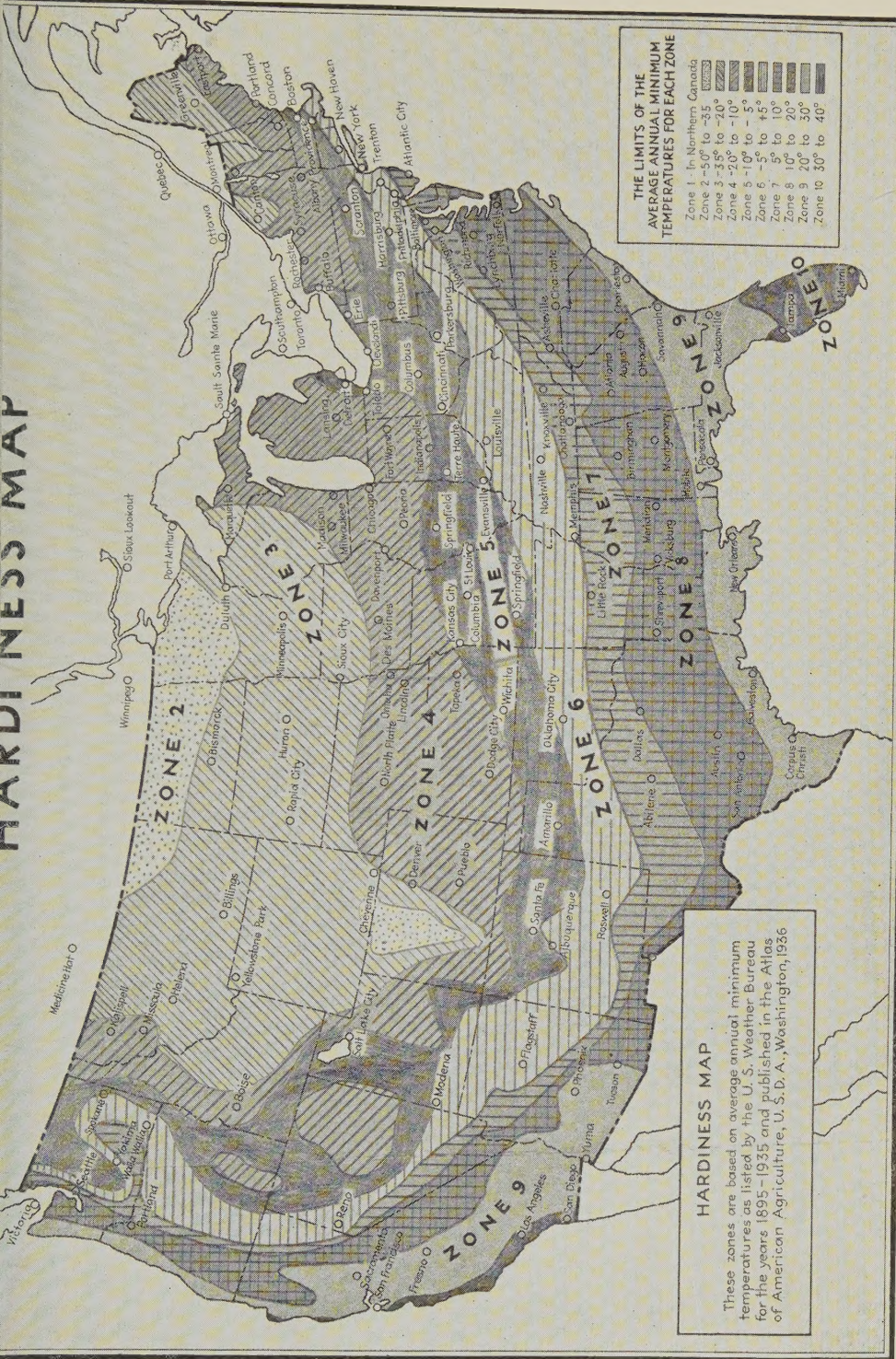
Hardiness of plants is an indeterminable quantity, based not only on a plant's resistance to minimum temperatures, but also on its resistance to maximum temperatures, and other factors such as lack of water, exposure, soil conditions, length of growing season, etc. It would be impossible to prepare a map depicting all these factors, though several might be included on a complex one. However, since a map based on the average annual minimum temperatures agrees in many instances with the known limits of hardiness of certain plants, these data were adopted as the basis for hardiness zones.

Figures for the average annual minimum temperatures were published by the U. S. Department of Agriculture in 1936, based on data compiled by the Weather Bureau over a period of forty years, 1895 to 1935, and these figures were used as a basis for the preparation of the Hardiness Map. For this purpose the United States and Canada were arbitrarily divided into ten zones, nine of which are in

the United States. These were based simply on 5, 10, or 15 degree differences in the average annual minimum temperatures. Professor Rehder used this same system in the first edition of his **Manual of Cultivated Trees and Shrubs** (1927); but since his work was published before the U. S. Weather Bureau figures were available, there are certain discrepancies between the zones as adopted by him and the temperature data as published in 1936. Professor Rehder's new revised **Manual** (1940) contains a map based on the later data and similar to the one shown in Plate VII, augmented somewhat by zone information for Canada.

On a small-scale map such as this, it is impossible to show all the minute climatic variations within the limits of each zone. In this same connection, certain strains of plants may prove hardier than others of the same species or botanical variety. Take, for instance, the Cedar of Lebanon (*Cedrus libani*) which was tried at the Arboretum unsuccessfully many times until seed was collected from the northernmost source of this plant in the Anti-Taurus Mountains in Asia Minor. Seedlings grown from this seed have proved perfectly hardy and have been growing in the Arboretum for the past 37 years. Similar variations in the hardiness of other plants of a single species or variety are common. If a map of any one of these zones were enlarged, various zone changes would be noted due to altitude alone. The Grand Canyon, for example, appears on our hardiness map in one climatic zone; yet there are at least four climatic zones in this one canyon, due, of course, to variations in altitude. Plants grow at the bottom of the Canyon which thrive in the Mexican deserts, yet on the North Rim (5700 feet above the Canyon floor) plants are found which are native as far north as southern Canada.

Consequently, many local variations in this small-scale map are to be expected. A plant is usually listed in the coldest zone where it will grow normally, but at the same time it can be expected to grow in many of the warmer zones where maximum temperatures and drought conditions might prove to be the only limiting factors. With these limitations in mind, the following plants are listed in the coldest zones where they can be expected to do well, simply as indicators for the large group of plants doing well in that particular zone. Using this general map as a basis and these lists of plants as indicators, similar hardiness maps could be worked out for limited areas or even for each state in the United States and each province in the Dominion of Canada, but in much greater detail. Such detailed maps would be of much greater value to local plantsmen than a general map covering the entire country, such as the one accompanying this article.



THE LIMITS OF THE AVERAGE ANNUAL MINIMUM TEMPERATURES FOR EACH ZONE

Zone 1	In Northern Canada
Zone 2	-50° to -35°
Zone 3	-35° to -20°
Zone 4	-20° to -10°
Zone 5	-10° to -5°
Zone 6	-5° to +5°
Zone 7	+5° to 10°
Zone 8	10° to 20°
Zone 9	20° to 30°
Zone 10	30° to 40°

HARDINESS MAP

These zones are based on average annual minimum temperatures as listed by the U. S. Weather Bureau for the years 1895-1935 and published in the Atlas of American Agriculture, U. S. D. A., Washington, 1936

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WOODY PLANTS HARDY IN DIFFERENT ZONES

Zone I

(This includes the Arctic Regions of northern Canada.)

Zone II

Acer negundo
Caragana arborescens
Cornus alba
Juniperus virginiana
Prunus virginiana

Zone VI

Berberis buxifolia
Bignonia capreolata
Ilex crenata
Myrica cerifera
Taxus baccata

Zone III

Euonymus alata
Ligustrum amurense
Lonicera tatarica
Philadelphus coronarius
Pinus strobus

Zone VII

Abelia triflora
Ilex cornuta
Prunus laurocerasus
Pyracantha crenato-serrata
Quercus virginiana

Zone IV

Abies concolor
Betula populifolia
Juniperus chinensis
Ligustrum vulgare
Tsuga canadensis

Zone VIII

Euonymus japonica
Ligustrum japonicum
Melia azedarach
Myrtus communis
Pittosporum tobira

Zone V

Abelia grandiflora
Berberis triacanthophora
Ilex opaca
Pieris japonica
Taxus cuspidata

Zone IX

Berberis darwini
Cinnamomum camphora
Cotoneaster pannosa
Nerium oleander
Raphiolepis umbellata

Zone X

Buginvillaea spectabilis
Cocos nucifera
Hibiscus rosa-sinensis

Musa sapientum
Roystonea regia

INCREASING THE ENDOWMENT OF THE ARBORETUM

Since the work of the Arnold Arboretum is dependent on the income from its restricted endowment, plus gifts for special or general purposes from its friends, it is very gratifying to report increases in the General Endowment Fund. Recently this Fund has been increased by two bequests totalling \$35,554.90. Of this, \$12,500.00 was from the estate of Miss Grace L. Edwards, formerly of Beacon Street, Boston, this being the final payment of her bequest of \$25,000.00; and \$23,054.90 from the estate of Mrs. James G. Freeman, formerly of Boston and Weston. The latter is added to the Laura Lucretia Case Fund which was established in 1925, the income to be used for the general purposes of the Arboretum. It is interesting to note that the total endowment of the Arnold Arboretum is made up of thirty-four different items, each being carried under the names of the individual donors.

GLOSSARY

The "Brief Glossary of the More Common Botanical and Horticultural Terms" published by the Arnold Arboretum as Bulletin Nos. 7-10 of the **Bulletin of Popular Information** (July 19, 1940) has proved overwhelmingly popular. A few copies of this still remain and can be purchased for 25 cents from the Arnold Arboretum, Jamaica Plain, Massachusetts.

DIRECTIONS FOR THE PREPARATION OF HERBARIUM SPECIMENS

The thirty-five page illustrated booklet by Dr. I. M. Johnston, entitled **The Preparation of Botanical Specimens for the Herbarium**, issued last year by the Arboretum, has proved to be so popular that the original edition is now exhausted. It is to be reprinted in a larger edition. Copies may be obtained from the Arnold Arboretum, price: 30 cents, prepaid.

INSECT PEST BOOKLET

An important booklet entitled **Important Tree Pests of the Northeast** has recently been published by the Massachusetts Forest and Park Association. This contains descriptions of 50 of the most important pests, written by a dozen or more experts. Full descriptions, pictures, and control are given for each. Further information concerning this excellent 187-page booklet may be obtained from Harris A. Reynolds, Secretary, Massachusetts Forest and Park Association, 3 Joy Street, Boston, Massachusetts.

DONALD WYMAN